Detecting graphene nanosheets on leaves of *Ceratophyllum Demersum*

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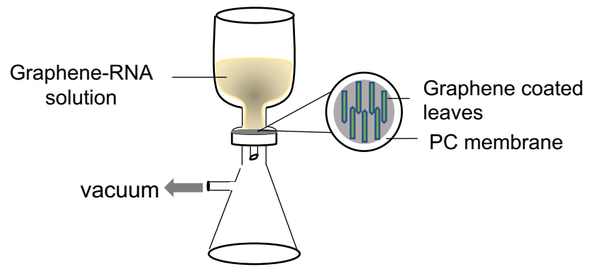
Introduction

- We have developed a method to image graphene flakes on leaves of aquatic plants using confocal microscopy

Method

Sample Preparation

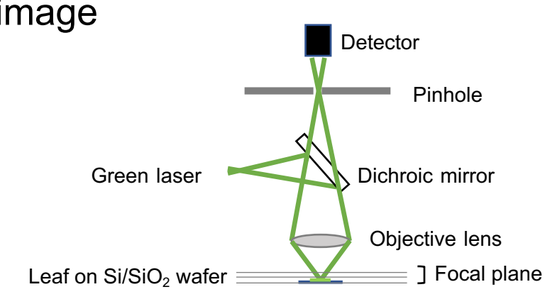
- 0.3g/L graphene-RNA6 solutions were prepared following standard procedure[1]
- Solutions were vacuum filtrated onto freshly plucked *Ceratophyllum Demersum* leaves on a 0.2 μm polycarbonate (PC) membrane



Vacuum filtration setup

Confocal Optical Microscopy

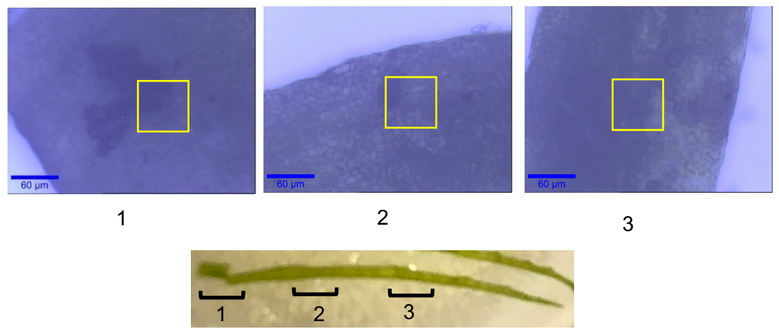
- Confocal microscopy was performed at 9 different heights on the leaves placed on a 300nm Si/SiO_2 wafer, using a green laser.
- The ability to change the height of the focal plane and capture and compare these images allows for the production of a 3D image



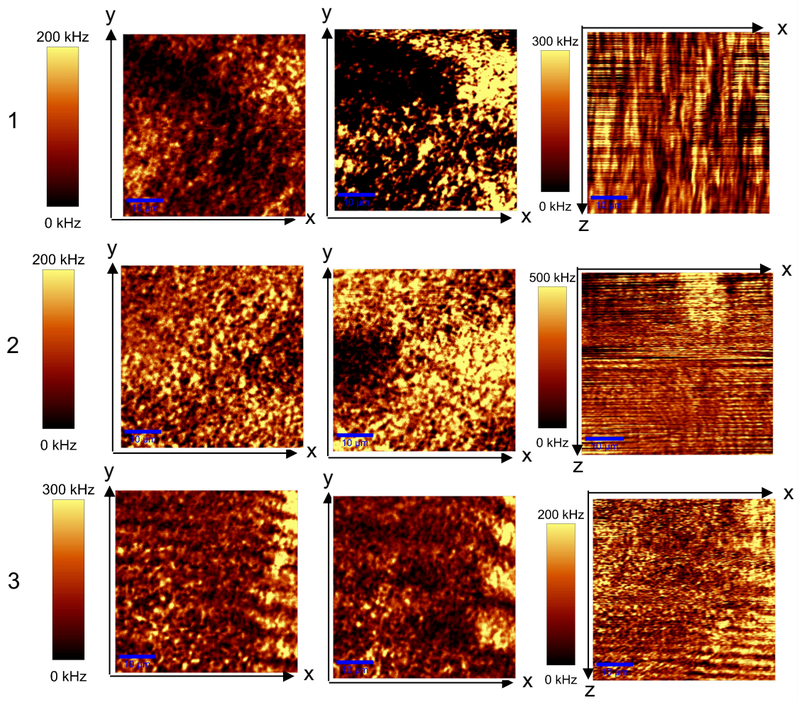
Confocal microscopy setup

Results

It was found that once vacuum filtrating 30 mL of the graphene-RNA6 solutions, large Graphene flakes on the surface of *Ceratophyllum Demersum* leaves could be found using an optical microscope.



Optical images of graphene flakes and a map of the the locations they were found on a *Ceratophyllum Demersum* leaf



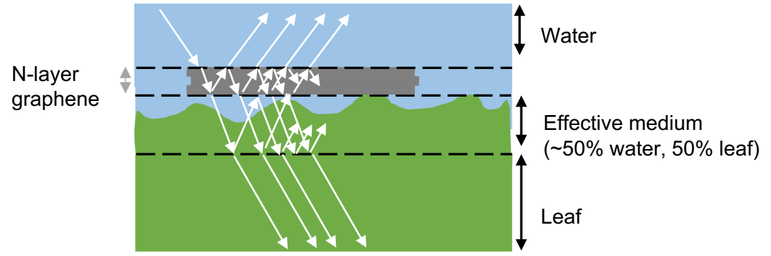
50 x 50 μm confocal images of graphene flakes taken at the surface and -5 μm, with corresponding depth image (50 μm deep)

Conclusion

- Using confocal microscopy, graphene flakes residing on the upper epidermis[3] of *Ceratophyllum Demersum* leaves were imaged, producing 3D images

Further Research

- Determine the thickness of graphene flakes using an optical model
- Investigate the effect that the presence of graphene flakes on leaves of aquatic plants has on photosynthesis



Possible model to determine thickness of graphene flakes using the concept of multiple beam interference (half arrows indicate the reflection pattern repeating infinitely)

References

[1]Sharifi, F. et al. (2012).Transparent and Conducting Graphene_RNA_Based Nanocomposites. *Small. 8(5),*699-706

[2]Blake, P. et al. (2007). Making graphene visible. *Applied Physics Letters. 91*(063124).

[3]Al-Abbawy, D. et al. (2020). Effects of salinity on biochemical and anatomical characteristics of *Ceratophyllum demersum* L. *Eurasia J BioSci. 14,* 5219-5225.

Acknowledgements

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…and Western's Faculty of Science for a USRI award